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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/769,554	01/30/2004	Chien-Min Sung	21154.DIV	5868

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EXAMINER	
PIZARRO CRESPO, MARCOS D	
ART UNIT	**PAPER NUMBER**
2814	

DATE MAILED: 11/29/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

H'A

Office Action Summary	Application No.	Applicant(s)	
	10/769,554	SUNG, CHIEN-MIN	
	Examiner	Art Unit	
	Marcos D. Pizarro-Crespo	2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 October 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-15 and 20-30* is/are pending in the application.

4a) Of the above claim(s) *2,3 and 22-30* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,4-15,20 and 21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) *1-15 and 20-30* are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

Attorney's Docket Number: 21154.DIV
Filing Date: 1/30/2004
Claimed Priority Date: 10/11/2002 (Divisional of 10/270,018)
Applicant(s): Sung
Examiner: Marcos D. Pizarro-Crespo

DETAILED ACTION

This Office action responds to the amendment filed on 10/3/2005.

Acknowledgment

1. The amendment filed on 10/3/2005, responding to the Office action mailed on 5/3/2005, has been entered. The present Office action is made with all the suggested amendments being fully considered. Accordingly, pending in this Office action are claims 1-15 and 20-30.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1, 4, 11-14, and 20 are rejected under 35 U.S.C. 102(e) as being anticipated by Hall (US 2002/0023733).

4. Regarding claim 1, Hall shows all aspects of the claimed invention including a method of making a diamond composite heat spreader comprising the steps of:

- Providing a first plurality of diamond particles having a first average mesh size (see, *e.g.*, par.0018/ll.13)
- Packing the diamond particles such that each diamond particle is substantially in contact with at least one other diamond particle (see, *e.g.*, par.0022/ll.29-37)
- Providing an interstitial material including Cu (see, *e.g.*, pars.0023,0029)
- Bonding the packed diamond particles with the interstitial material such that the interstitial material at least partially fills any voids between the packed diamond particles (see, *e.g.*, par.0025/ll.1-8)

5. Regarding claim 4, Hall infiltrates the interstitial material to perform the bonding step (see, *e.g.*, par.0029).

6. Regarding claim 11, Hall shows the diamond particles contacting one another sufficiently to provide a continuous diamond-to-diamond path to substantially each of the plurality of diamond particles (see, *e.g.*, par.0022/ll.53-56 and par.0035/ll.9-10).

7. Regarding claim 12, Hall shows the method further comprising the steps of:

- Providing a porous ceramic material prior to the step of bonding
- Placing the ceramic material adjacent to the packed diamond particles prior to the step of bonding

8. Regarding claim 13, Hall shows the ceramic material comprising 100% WC.

9. Regarding claim 14, Hall shows the step of bonding is performed at a pressure between about 4GPa and about 6GPa.

10. Regarding claim 20, Hall shows the interstitial material made from Al.

Claim Rejections - 35 USC § 103

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

12. Claims 1, 4, 5, 7-10, 12, 13, 15, 20, and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (US 5096465) in view of Howard (US 3829544), Tzeng (US 6284315) and Nishibayashi (JP 9-312362).

13. Regarding claim 1, Chen shows (see, *e.g.*, fig. 2) most aspects of the instant invention including a method of making a diamond composite comprising the steps of:

- Providing a first plurality of diamond particles **10** having a first average mesh size (see, *e.g.*, col.6/ll.23)
- Packing the diamond particles **10** such that each diamond particle is substantially in contact with at least one other diamond particle (see, *e.g.*, fig.2)
- Providing an interstitial material **18** including Cu (see, *e.g.*, fig. 2, col.8/ll.54)

- Bonding the packed diamond particles with the interstitial material such that the interstitial material at least partially fills any voids between the packed diamond particles (see, *e.g.*, col.8/ll.34-43)

Chen also teaches that his diamond composite may be used as a cutting tool for drilling bits (see, *e.g.*, col.6/ll.5-15). He, however, fails to specify that the composite may also be used as a heat spreader. Howard, on the other hand, teaches that Chen's diamond composite have particular utility not only as a cutting tool for drilling bits but also as a heat sink (see, *e.g.*, col.4/ll.1-7). Likewise, Tzeng teaches that diamond posses a number of desirable properties making it important not only in drilling bits but also in heat sinks (see, e.g., col.1/ll.20-27). Nishibayashi teaches that thermal energy is usually transmitted faster in diamond than in any other material (see, *e.g.*, par. 0003). Moreover, diamond has a thermal expansion rate lower than ordinary semiconductor materials (see, *e.g.*, par. 0003). Heat spreaders consisting of diamond composites similar to the one of Chen have superior applicability (see, *e.g.*, par. 0032). They can be used, for example, to reduce warping due to thermal expansion differences between the spreader and a semiconductor (see, *e.g.*, par. 0032).

It would have been at the time of the invention to one of ordinary skill in the art to use Chen's diamond composite to make a heat spreader, as suggested by Howard, Tzeng, and Nishibayashi, to quickly transmit heat away from a heat source.

14. Regarding claims 4 and 5, Chen shows that the bonding is performed by infiltration at about 1,1000°C (see, e.g., col.8/ll.45-50).

15. Regarding claim 7, Chen teaches that the step of packing further comprises packing diamonds to over 50% by volume of the composite prior to providing the interstitial material (see, *e.g.*, col.7/ll.63).

16. Regarding claim 8, Chen teaches that prior to the step of providing an interstitial material, the method further comprises the step of adding a second plurality of diamond particles having a second average mesh size, which is smaller than the first mesh size, to the packed diamond particles such that the second plurality of diamond particles at least partially fill in the voids between the larger particles to produce a packed collection of diamond between about 50% and about 80% by volume of diamond (see, *e.g.*, col.7/ll.35-64)

17. Regarding claims 9 and 10, Chen teaches the second mesh-size particles having a diameter of between about $1/10^{th}$ and about $1/5^{th}$ the diameter of the first mesh-size particles (see, *e.g.*, col.7/ll.44-45).

18. Regarding claims 12 and 13, Chen shows the method further comprising providing a WC material prior to the bonding step and placing the WC material adjacent to the packed diamond particles prior to said bonding step (see, *e.g.*, col.8/ll.6-12,40).

19. Regarding claim 15, Chen teaches that the diamond particles have a size of from about 400 mesh to about 18 mesh (see, *e.g.*, col.6/ll.25).

20. Regarding claim 20, Chen shows the interstitial material is a Cu alloy (see, *e.g.*, col.8/ll.54).

21. Regarding claim 21, Chen shows the interstitial material may be a Si alloy of Ni and Cr (see, *e.g.*, col.9/ll.65-68).

22. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen/Howard/Tzeng/Nishibayashi in view of Sung (US 6039641).

23. Regarding claim 6, Chen/Howard/Tzeng/Nishibayashi show most aspects of the instant invention (see, *e.g.*, paragraph 13 above), except for the infiltration step being performed in a vacuum furnace at a pressure below about 10^{-3} torr. Sung, on the other hand, teaches that the environment for infiltration may be controlled to provide superior performance by maintaining a vacuum below about 10^{-3} torr (see, *e.g.*, col.13/ll.15-25).

It would have been obvious at the time of the invention to one of ordinary skill in the art to perform the infiltration step of Chen/Howard/Tzeng/Nishibayashi in a vacuum furnace below about 10^{-3} torr, as suggested by Sung, because doing so would allow controlling the infiltration environment to provide superior performance.

24. Claim 1, 11-14, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pender (US 6541115) in view of Howard, Tzeng, and Nishibayashi.

25. Regarding claim 1, Pender shows most aspects of the instant invention including a method of making a diamond composite comprising the steps of:

- Providing a first plurality of diamond particles having a first average mesh size (see, *e.g.*, col.6/ll.21-23,40-45)
- Packing the diamond particles such that each diamond particle is substantially in contact with at least one other diamond particle (see,*e.g.*,fig.4)
- Providing an interstitial material including Ag (see, *e.g.*, col.5/ll.25)

- Bonding the packed diamond particles with the interstitial material such that the interstitial material at least partially fills any voids between the diamond particles (see, *e.g.*, col.7/ll.15-20)

Pender also teaches (see, *e.g.*, col.1/ll.5-10, col.6/ll.24,35) that his composite may be used as diamond composite cutting tool but fails to specify that it may be used as a heat spreader. Howard, on the other hand, teaches that Pender's diamond composite also has particular utility as a heat sink (see, *e.g.*, col.4/ll.1-7). Likewise, Tzeng teaches that diamond posses a number of desirable properties making Pender's diamond composite important for heat sink applications (see, *e.g.*, col.1/ll.20-27). Nishibayashi teaches that thermal energy is usually transmitted faster in diamond than in any other material (see, *e.g.*, par. 0003). Moreover, diamond has a thermal expansion rate lower than ordinary semiconductor materials (see, *e.g.*, par. 0003). Heat spreaders consisting of diamond composites similar to the one of Pender have superior applicability (see, *e.g.*, par. 0032). They can be used, for example, to reduce warping due to thermal expansion differences between the spreader and a semiconductor (see, *e.g.*, par. 0032).

It would have been at the time of the invention to one of ordinary skill in the art to use Pender's diamond composite to make a heat spreader, as suggested by Howard, Tzeng, and Nishibayashi, to quickly transmit heat away from a heat source.

26. Regarding claim 11, Pender shows the diamond particles contacting one another sufficiently to provide a continuous diamond-to-diamond path to substantially each of the plurality of diamond particles (see, *e.g.*, fig. 5).

27. Regarding claims 12 and 13, Pender shows the method further comprising providing a WC material prior to the bonding step and placing the WC material adjacent to the packed diamond particles prior to the bonding step (see, *e.g.*, col.7/ll.34).

28. Regarding claim 14, Pender shows the interstitial material may be Cu (see, *e.g.*, col.5/ll.27), and that the bonding step is performed at a pressure of about 4GPa (see, *e.g.*, col.7/ll.1).

29. Regarding claim 20, Pender shows the interstitial material is Ag (see, *e.g.*, col.5/ll.25).

Response to Arguments

30. The applicant argues:

> Amended claim 1 requires that the interstitial material includes Ag, Cu, Al, Si, or Bni2. The Hall reference fails to disclose a mass of packed diamond particles bonded together by any of the listed and claimed interstitial materials. Hall does disclose a number of bondable materials which include Cu and Al. However, these are not interstitial materials used to bond the particles together. Rather, these bondable materials pool in a layer on an opposite surface of the spreader.

The examiner responds:

The features upon which the applicant relies (*i.e.*, an interstitial material bonding the diamond particles together) are not recited in the rejected claim(s). The claims recite that the particles are bonded *with* the interstitial material not that they are bonded *by* the interstitial material. Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). In any event, Hall clearly shows the claimed features of the invention. See, *e.g.*, par .0023 and 0029, where Hall teaches that some of the copper may be infiltrated in the diamond mass

wherein some of the copper is allowed to remain in the matrix to strengthen the bond between the diamond and the copper layer which is formed on the opposite surface of the matrix.

31. The applicant argues:

> Hall's diamond mass contains cobalt remaining within the mass. In the context of the claimed invention, cobalt is an undesirable component as it has very low thermal conductivity and reduces the overall thermal conductivity and effectiveness of the heat spreader.

The examiner responds:

Applicant's arguments contradict their own teachings. See, *e.g.*, pp.5/ll.4,20, pp.13/ll.10,15, and pp.17/ll.14 of the instant specification, where the applicant listed cobalt as one of their interstitial materials. The only issue with cobalt, as taught by the applicant, comes at low-pressure sintering. However, at ultrahigh pressures cobalt can aid in sintering the diamond grains by forming diamond-to-diamond bridges resulting in an efficient heat spreader with very high diamond content (see, *e.g.*, pp.18/ll.9 and pp.19/ll.1-12). Hall's process parameters include ultrahigh pressure (see, *e.g.*, par.0022/ll.4). Therefore, according to applicant's teachings, Hall's process results in an efficient heat spreader with a very high diamond content.

32. Applicant's arguments with respect to the claims have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

33. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

34. A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

35. Papers related to this application may be submitted directly to Art Unit 2814 by facsimile transmission. Papers should be faxed to Art Unit 2814 via the Art Unit 2814 Fax Center. The faxing of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2814 Fax Center number is **(571) 273-8300**. The Art Unit 2814 Fax Center is to be used only for papers related to Art Unit 2814 applications.

36. Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Marcos D. Pizarro-Crespo** at **(571) 272-1716** and between the hours of 9:30 AM to 8:00 PM (Eastern Standard Time) Monday through Thursday or by e-mail via Marcos.Pizarro@uspto.gov. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy, can be reached on (571) 272-1705.

37. Any inquiry of a general nature or relating to the status of this application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status

information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

38. The following list is the Examiner's field of search for the present Office Action:

Field of Search	Date
U.S. Class/Subclass(es): 438/15,25,26,51,55,64,105,106,122,584,FOR413	11/15/05
Other Documentation: PLUS Analysis	4/26/05
Electronic Database(s): EAST (USPAT, EPO, JPO)	11/15/05

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